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D. U. HOWARD

3,609,772

VEHICLE FLUSH TOILET

Filed Aug. 7, 1969

3 Sheets-Sheet 1

FIG. 1.

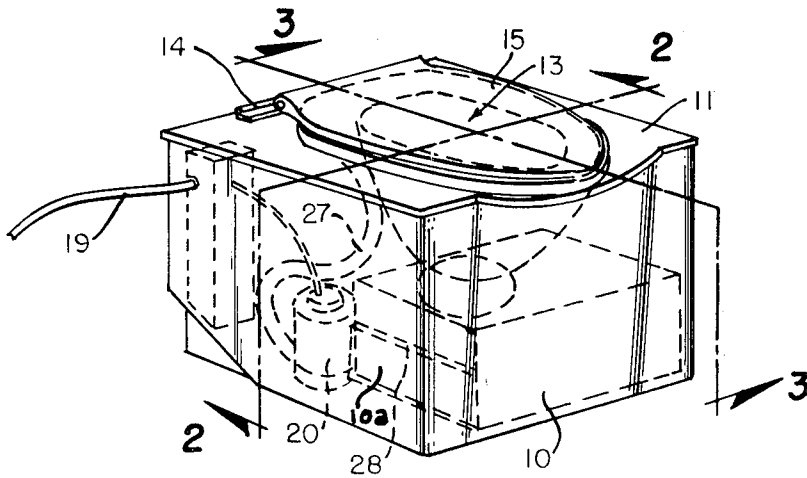
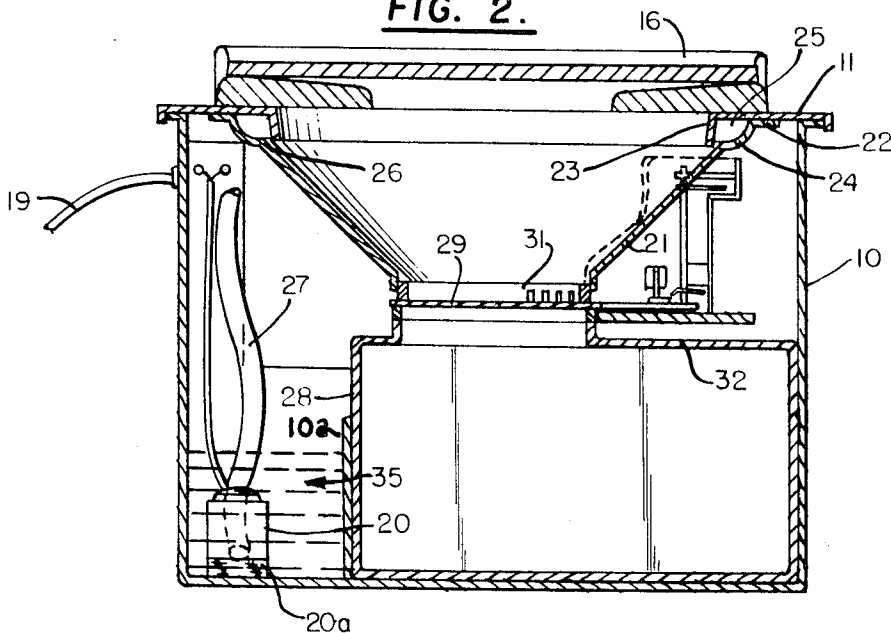


FIG. 2.



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FIG. 3.

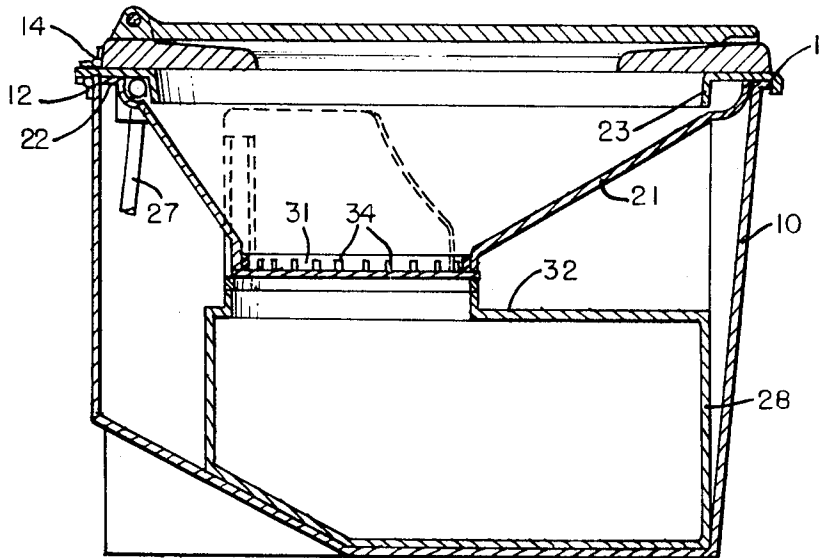


FIG. 9.

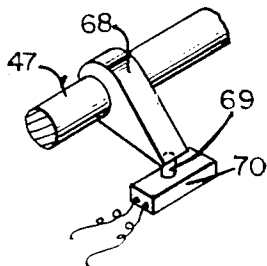


FIG. 6.

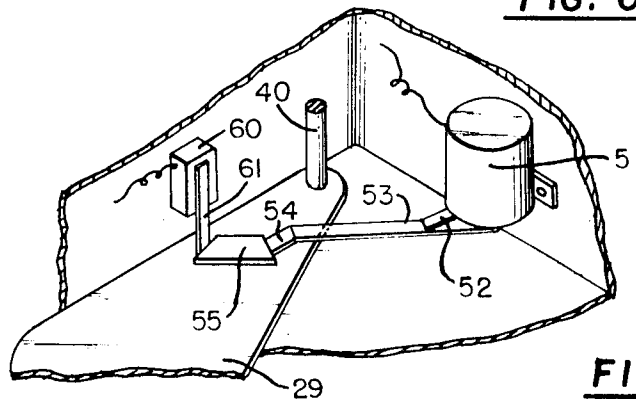


FIG. 7.

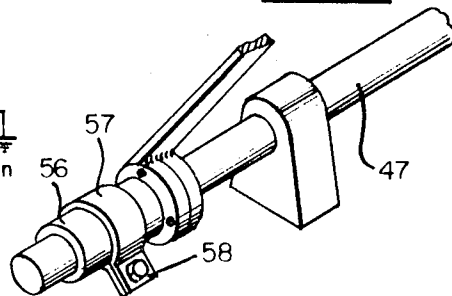
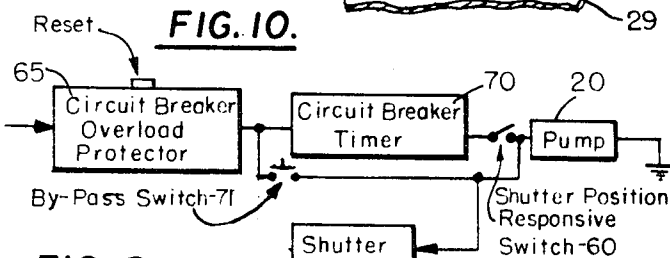
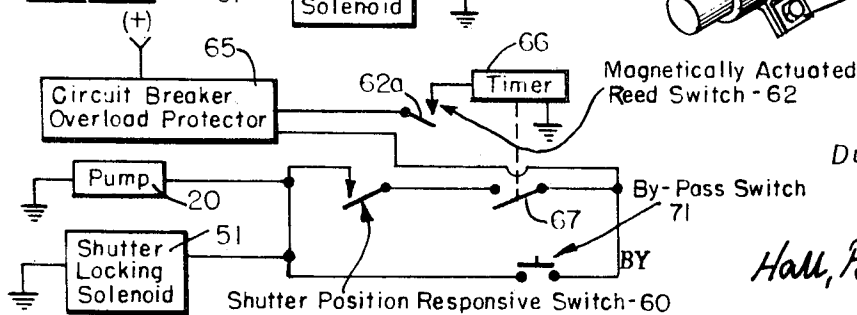


FIG. 8.



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FIG. 4.

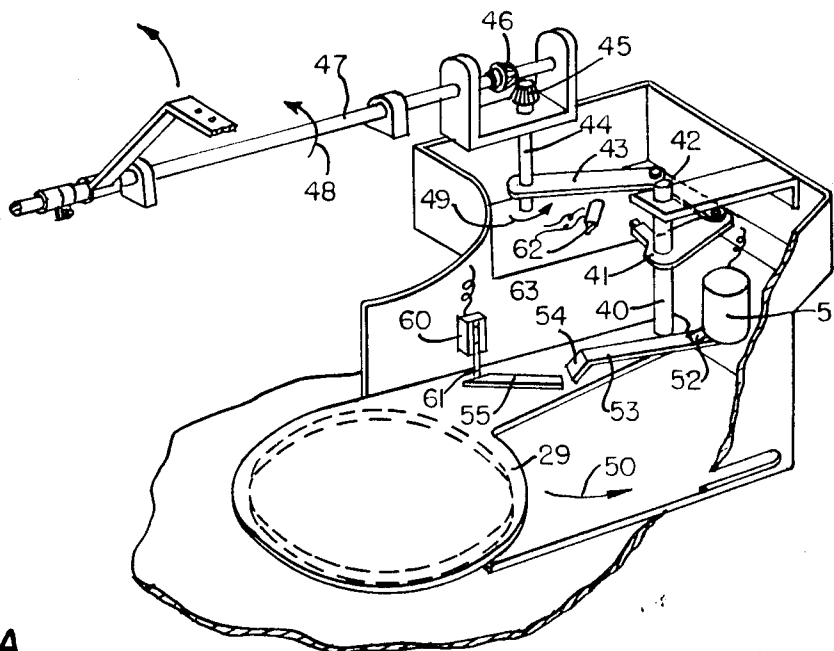


FIG. 5A.

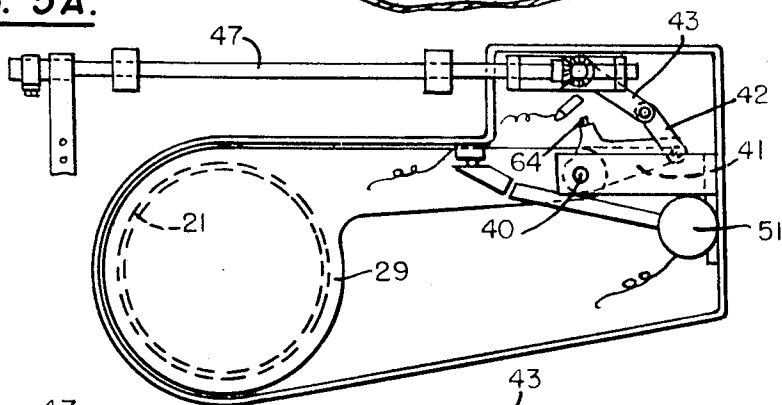
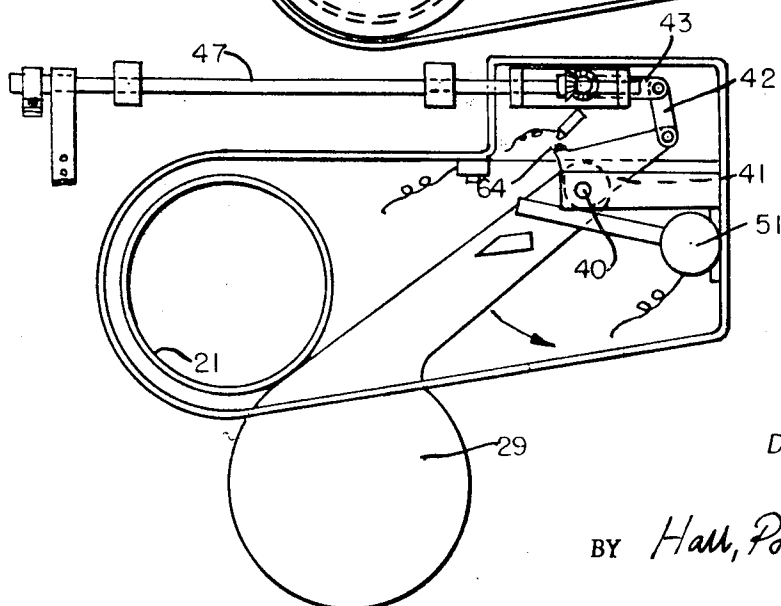


FIG. 5B.

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7 Claims

ABSTRACT OF THE DISCLOSURE

The disclosure relates to a flush toilet for vehicles or the like. A storage receptacle receives waste from a bowl with which it communicates when an intervening shutter is open. During the flushing cycle, the shutter is closed and flushing fluid is pumped from a separate reservoir to the bowl and thence back to the reservoir, bypassing the receptacle. A cover for the flush toilet is openable and is mechanically coupled to the shutter so that the shutter is opened when the cover is raised. A means is provided for latching the shutter in the closed position during the flushing cycle, and the mechanical interconnection between the shutter and the cover permits raising the cover even when the shutter is locked in the closed position.

BACKGROUND OF THE INVENTION

This invention relates to a flush toilet for use in vehicles or the like, and is particularly adapted for use in aircraft, boats, trailers, etc. The toilet of this invention is of the type having a waste storage compartment which is periodically emptied as, for example, at the end of a trip. More particularly, the invention relates to a vehicle toilet of the flush type which requires the use of only a relatively small quantity of flushing fluid, which flushing fluid may be used repeatedly without becoming appreciably contaminated.

With the increasing emphasis on avoidance of pollution of streams and lakes, it is becoming mandatory in many localities to provide a toilet for use on boats, camping trailers, and the like which is so constructed as to prohibit absolutely the discharge of waste material, and particularly human waste material, from such vehicles. Although vehicle toilets have been developed and are in use, for example in aircraft, which are of the flush type and provide for storage of the waste material until it can be removed from the toilet, such toilets of the prior art have numerous disadvantages. For example, in the toilets in common use in modern day aircraft, flushing water is provided and also means for separating solid waste materials from liquid waste materials; however, no means is provided for separating the liquid waste materials from the flushing water with the result that the flushing water becomes grossly contaminated after only several uses of the toilet. Even though such toilets employ means for chemically treating the flush water, it is common for the flush water to become contaminated very quickly despite such treatment with the result that a very unsanitary and odorous condition soon occurs.

SUMMARY OF THE INVENTION

Described briefly, the vehicle toilet of the present invention provides for a storage compartment or reservoir for a flushing medium such as water, and a separate compartment or receptacle for the storage of both solid and liquid waste materials. After each use, the bowl is flushed, but the flushing water is maintained substantially isolated from the storage receptacle so that a relatively small quantity of flushing water may be used over and over with only a minimal amount of contamination resulting. Because of this, the toilet of this invention is maintained in an entirely sanitary condition throughout repeated usage and is also substantially entirely free of odor. In addition,

the construction of the toilet of this invention is such that removal of the waste material at the end of a trip is very readily accomplished and only a minimal amount of treatment is required to reinstate the toilet to a condition suitable for use on a subsequent trip.

The flush toilet of this invention is provided with a cover which normally overlies the seat and is preferably hingedly connected to the outer toilet casing. A mechanical interconnection is provided which couples the cover to a shutter, which shutter in the closed position blocks communication between the bowl and a separate compartment or receptacle for storage of the solid and liquid waste materials, but which nevertheless permits the flushing fluid to pass from the bowl back to its separate storage compartment or reservoir. When the flush toilet is to be used, raising the cover opens the aforesaid shutter, thereby providing communication between the bowl and the waste receptacle.

An interlock is provided whereby the flushing fluid can flow over its predetermined flow path only when the shutter is in the closed position, the reason for this being to prevent loss of the flushing fluid into the waste receptacle. Once the flushing cycle is under way, the shutter is locked in the closed position and cannot be opened until the flushing cycle is completed. Recognizing that there may nevertheless be occasions when the aforesaid cover may nevertheless be raised during the flushing cycle, the mechanical interconnection between the cover and the shutter is constructed so as to permit this to take place without damaging the interconnection or the shutter itself.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a view, in perspective, of the toilet of the present invention;

FIG. 2 is a sectional view of the toilet of FIG. 1 taken along the section line 2-2 of FIG. 1;

FIG. 3 is a further sectional view of the toilet of FIG. 1 taken along the section line 3-3;

FIG. 4 is a perspective view of the shutter and of the mechanical interconnection between the shutter and the cover;

FIG. 5A is a plan view of the mechanism of FIG. 4 illustrating the shutter in closed position;

FIG. 5B is a plan view of the mechanism of FIG. 4 showing the shutter in the open position;

FIG. 6 is a detailed view of the mechanism for locking the shutter into closed position during the flush cycle;

FIG. 7 is a detailed view of the slip-joint in the mechanical interconnection between the cover and the shutter;

FIG. 8 is a circuit diagram for one embodiment of the invention;

FIG. 9 is a perspective view of an alternate embodiment of apparatus employing a circuit breaker timer; and

FIG. 10 is a circuit diagram for the alternative embodiment employing the circuit breaker.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to FIG. 1, the toilet of the present invention is shown as comprising an oblong container or casing 10 which may be formed of metal or plastic or any other suitable material having a cover 11 which is hinged to container 10 by means of a hinge 12. Cover 11 defines a central aperture therein at 13, and fitted to the top of cover 11 and hinged thereto by means of hinge 14 so as to surround the central aperture 13 is a seat 15. On top of the seat 15 is a lid 16 which is also hingedly connected by means of a hinge (not shown) to the cover 11. The lid 16 is not only intended for closing the top of the toilet and for decorative purposes, but also raising and lowering this lid 16 controls operation of the toilet as will hereinafter be explained.

Power for the entire unit is provided from a suitable energy source via power cord 19. In the left-front interior portion of the casing 10 is positioned a pump 20 whose sump 20a is immersed in a flush water reservoir 35.

The sectional view of FIG. 2 discloses an annular bowl member 21 whose upper rim 22 is secured to the inner surface of cover 11. As shown, the central aperture 13 is defined in lid 16 by means of a downturned rim 23 which, together with the curved portion 24 of bowl 21 forms an annular space 25 which communicates with the interior of bowl 21 through the small annular recess 26. By means of this arrangement, flush water is forced through the hose or tube 27 from pump 20 and into the annular space 25 and is carried in a swirling fashion around the annular space 25 and then downwardly through aperture 26 so as to rinse the entire inner surface of bowl 21.

The interior of bowl 21 is capable of communicating with a solid and liquid waste receptacle or chamber 28 dependent on the position of a shutter 29 which is normally maintained in a closed position when the lid 16 is in a closed position shown in FIG. 2.

Bowl 21 is secured to cover 11, and therefore the raising of cover 11 lifts bowl 21 and also the shutter 29 together with the associated shutter-operating mechanism, thereby exposing the interior of receptacle 28. Receptacle 28 may then readily be removed from the outer casing 10 to permit disposal of the waste materials. If desired, a cover (not shown) for waste receptacle 28 may be secured to the interior wall of the casing 10 so that this cover may be readily placed upon the opening in waste receptacle 28 when lid 11 is raised, thereby permitting removal of the receptacle 28 in an entirely sealed condition so as to prevent the escape of noxious odors from receptacle 28.

FIGS. 2 and 3 show how the space which surrounds receptacle 28 but lying within the walls of container or casing 10 forms a storage space for flushing fluid, which flushing fluid may comprise water alone or, if desired, water together with a suitable disinfectant material. The sump 20a of pump 20 is immersed in this flushing fluid, and FIG. 3 shows that the outlet tube or hose 27 from the pump is connected to the annular chamber 25 in such a manner that the discharging fluid from tube 27 will flow substantially tangentially from the outlet end of tube 27 within the annular recess 25.

It can be seen in both FIGS. 2 and 3 that a compartment is defined on the inner bottom wall of casing 10 by upstanding walls 10a and this compartment is adapted to receive the waste receptacle 28. Such compartment not only holds receptacle 28 securely in position but, since the walls 10a are preferably imperforate, the compartment is not ordinarily wetted by the flushing fluid so that the bottom and sides of receptacle 28 remain dry and do not drip when it is removed for servicing.

FIGS. 2 and 3 also disclose an annular member or element 31, which is preferably formed of a flexible material such as rubber, and which is affixed to the bottom discharge opening of bowl 21 in any suitable manner as, for example, with a suitable adhesive material. The member 31 is provided over a portion of its circumference with apertures 34 which are of such a size that they permit flush water which is admitted to the interior of bowl 21 to pass therethrough and out over the outer top wall 32 of receptacle 28 to the flush water reservoir 35. The apertures 34 are sufficiently large so that the entire quantity of flush water which is used during a flushing operation may quickly pass out through the plurality of apertures 34 back to the flush water reservoir 35, but are small enough so that any solid waste or tissue paper will not pass therethrough but will instead be retained upon the upper surface of the shutter 29.

Since member 31 is formed preferably of a resilient material described above, and since shutter 29 when closed has its upper surface bearing directly against the

lower annular rim of member 31, it is apparent that the opening of shutter 29 will cause any solid material lying thereon to be swept off by such rim, thereby causing such solid material to fall into receptacle 28.

As is apparent from FIGS. 2 and 3, the apertures 34 in member 31 are provided over only a portion of the circumference, and the reason for this is that this tends to produce a current of flush water over the surface of shutter 29 in a direction toward the apertures 34 so that any tissue paper or the like which rests upon the upper surface of shutter 29 or is washed thereupon during the flushing action will be flushed toward the apertures 34 and thus act as a filter to permit the liquid flush water to pass therethrough while retaining any solid wastes which may have been removed from the bowl surface during the flushing operation.

The mechanism for operating the shutter 29 is illustrated in FIGS. 4, 5A, 5B, and 7. The shutter element 29 is rotatable about a pivotal support member 40 by means of actuating members 41, 42, and 43. Member 43 is rigidly secured to a shaft 44 which has a bevel gear member 45 secured thereto at its upper end. Gear member 45 meshes with a corresponding bevel gear member 46 which rotates with shaft 47. Shaft 47, in turn, is rotated in response to the elevation or lowering of the lid 16 previously described in connection with FIG. 2. Thus, it will be apparent that raising of the lid 16 rotates shaft 47 in the direction of the arrow 48, thereby rotating shaft 44 in the direction of arrow 49, and consequently rotating link 43 in the counterclockwise direction about the axis of shaft 44. This action produces a translatory motion of link 42 which then rotates member 41 in a counterclockwise direction as well so as to rotate both shaft 40 and shutter 29 in the counterclockwise direction. It will be apparent then that raising of the lid causes the shutter 29 to move in the direction of arrow 50 so as to provide direct communication between bowl 21 and the waste receptacle compartment 28.

FIG. 7 illustrates in greater detail the manner in which the lid 16 is mechanically coupled to shaft 47 in such manner as to permit raising and lowering of the lid even when the shutter to which it is coupled is locked in position or when the lid and associated shutter are out of phase with each other under circumstances now to be described. Thus, as will now be described, the shutter is locked in the closed position during the flushing cycle, and the reason for this of course is to prevent the flushing fluid from passing into the waste receptacle 28 during flushing cycle. This is accomplished by actuating solenoid 51 whenever the pump 20 is operating. When solenoid 51 is so energized, its armature 52 is depressed, thereby urging member 53 downwardly against the action of a spring (not shown) so that the remote end of member 53 at 54 is butted against the end of a strip 55 which is secured to the top surface of shutter member 29. It can be seen that this butting action will prevent opening of the shutter 29 whenever solenoid 51 is energized.

It is recognized, of course, that the lid 16 may nevertheless be raised during a flushing cycle when the shutter 29 is locked in the closed position. To guard against breakage of any of the coupling parts should this occur, a slip-joint connection is provided between the lid 16 and shaft 47, and such slip-joint coupling takes the form of a partially resilient bushing 56 which may be formed of nylon or the like and which surrounds shaft 47. Surrounding the bushing 56 is an encircling sleeve 57 which is provided with a screw adjustment at 58 for controlling the amount of frictional force between member 57 and the nylon sleeve 56. The frictional force is adjusted so that the torque applied to shaft 47 upon rotation of the lid 16 upwardly or downwardly will in all instances be capable of operating shutter 29 between its open and closed positions. However, in the event of blockage of the movement of shutter 29, the member 57 may slip about the nylon member 56 to permit raising of the lid 16 without rotation

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of the shaft 47. Of course, when this occurs, the lid 16 and shutter 29 may then be considered to be out-of-phase relative to each other, but this condition is readily corrected when the lid 16 is again lowered since such operation cannot, of course, result in actuation of the already-closed shutter 29 with the result that slippage once again occurs as the lid 16 is operated to the closed position.

FIGS. 5A, 5B, and 6 illustrate one manner in which a suitable electrical input may be provided to initiate actuation of the pump 20. Thus, as shown in FIG. 4, a micro-switch 60 is provided whose actuating blade 61 is operated by member 55 on the upper surface of shutter 29 whenever the shutter is in the closed position. The contacts of the microswitch 20 may be connected in series with the pump motor to ensure that operation of the pump can occur only when the shutter is closed. The purpose of this, of course, is to guard against the possibility that the pump will operate and pump the flushing fluid, with the shutter 29 open, into the waste receptacle 28. Of course, the contacts of microswitch 60 are normally in the closed position since the shutter 29 is normally closed as a result of the fact that the lid 16 is normally in the lowered position. For this reason, the contacts of switch 60 cannot be used to initiate operation of the flushing cycle. Instead, a magnetically operated reed switch 62 is provided which is securely mounted to a supporting shelf 63, and with switch 62 being operated by a permanent magnet 64 connected to actuating arm 41. Thus, as can be seen by comparing FIGS. 5A and 5B, whenever the shutter is operated between its open and closed positions, the permanent magnet 64 passes in close proximity to the tip of the switch member 62 thereby causing a momentary closure of its contacts. Such contact closure provides an input signal to a timer which initiates operation of pump 20 for a predetermined interval of time.

FIG. 8 is a circuit diagram illustrating the manner in which the various electrical components are interconnected so as to produce the desired operation of the pump and the shutter locking solenoid. Thus, energy is supplied from the (+) terminal to a circuit breaker overload protector 65 whose function, of course, is to guard against short circuits or other conditions causing an electrical overload. If such overload occurs, the circuit breaker interrupts the circuit; thereafter the circuit breaker can be reset by actuating a reset button incorporated therein.

The reed switch 62 which is magnetically actuated by the permanent magnet 64 is schematically shown in FIG. 8 as controlling the application of energy to timer 66. From the description previously given, it will be recognized that the contacts 62a of the reed switch 62 closes only momentarily whenever the shutter is opened or closed so that such momentary contact closure provides only a short pulse of current to timer 66 to initiate its timing operation. The time interval demarcated by this timer is preferably chosen to correspond to the desired length of the flush cycle and may, for example, be in the order of twelve seconds. Throughout the interval being demarcated by timer 66, its associated contact 67 is closed to thereby condition the pump energization circuit for the application of electrical energy from terminal (+). However, the pump 20 can only be energized when the shutter position-responsive switch 60 is closed as it is whenever the shutter 29 is in the closed position shown, for example, in FIG. 5A. Thus, upon the initiation of timing by timer 66, pump 20 is energized but only if switch 60 is also closed to ensure that the shutter 29 is in the closed position. It will be noted that whenever pump 20 is energized, electrical energy is also applied to the shutter locking solenoid 51 which then holds shutter 21 in the closed position throughout the pump operating cycle as previously described.

An alternative arrangement for controlling the energization of the pump which does not require the use of a timer is shown in the alternative embodiment of FIGS. 9 and 10. Thus, FIG. 9 shows a crank arm which is directly

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coupled to the shaft 47 so that it rotates in one direction or the other as the lid 16 is lowered or raised. Whenever lid 16 is in the lowered position, the arm 68 is moved to the position shown in FIG. 9 where it makes contact with a contactor button 69 of a trip-free circuit breaker 70.

FIG. 10 illustrates the manner in which the circuit breaker 70 is used to control operation of the pump 20 and shutter locking solenoid 51. Thus, as before, electrical energy is applied from the terminal (+) to the circuit breaker overload protector 65. Here again, the function of this circuit breaker is to provide overload protection for the entire circuit, the circuit breaker opening the circuit whenever the total current drawn by the system is in excess of a predetermined value. From the overload protector 65, current is applied to the circuit breaker 70 which performs a timing function, and thence to the pump 20 and to the parallel-connected shutter locking solenoid 51.

The rating of the circuit breaker 70 is selected so as to be less than the current normally drawn by both the pump 20 and solenoid 51. Consequently, whenever this circuit is energized, an overload of current passes through the circuit breaker 70 so that it will eventually open the circuit, but the time required to do this is a function of the amount of overload, and by properly selecting the rating of the circuit breaker 70, it can be controlled to open the circuit only after a suitable time, such as twelve seconds or so, has elapsed from the time of initiation of operation of pump 20. This makes it possible, therefore, to energize the pump 20 and also of course the shutter locking solenoid 51 for a predetermined time interval without requiring the use of a complex timing circuit.

A trip-free circuit breaker of the kind illustrated in FIGS. 9 and 10 is characterized by having contacts which are closed whenever a push-button 69 associated therewith is depressed, and the circuit remains intact while the push-button is depressed unless the current passing through the circuit exceeds the current rating of the device. In the event of a circuit overload, the time required for the circuit breaker to open is a function of the magnitude of the current excess over the rated value. Moreover, such a circuit breaker does not reset itself when the circuit has been opened for a time but only when the associated push-button 69 has been opened and then again closed.

Both FIGS. 9 and 10 illustrate the use of a by-pass switch 71 which may be used to energize pump 20 and solenoid 51 independently of timer 70 and independently also of the condition of the shutter position-responses switch 60. Such by-pass switch 71 may be located on an electrical control panel positioned on an outside wall of casing 10 and is highly useful for checking operation of the system, for troubleshooting, and also for pumping out the contents of the flushing fluid reservoir when it is desired that this fluid be removed and replaced with fresh fluid. Thus, when an attendant lifts the lid 16 the shutter 29 is opened as is customary. If now the by-pass switch 71 is closed, pump 20 will be actuated directly even though shutter 29 is now open, and the fluid in the reservoir 35 will now be flushed through the bowl 21 directly into the waste receptacle 28 thereby quickly emptying the reservoir and conditioning the toilet for receiving a supply of fresh flushing fluid.

What I claim is:

1. A flush toilet for use in vehicles or the like comprising in combination:
 - a toilet bowl having a bottom outlet,
 - a receptacle positioned below said bowl for receiving liquid and solid wastes admitted to said bowl and passing through said bottom outlet,
 - closure means operable between opened and closed positions for selectively permitting solid and liquid wastes to pass from said bowl to said receptacle,
 - a separate reservoir for flushing fluid,
 - flow control means for forcing said fluid from said reservoir to said bowl to flush said bowl,

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means for providing a return flow path for said flushing fluid from said bowl to said reservoir bypassing said receptacle when said shutter is in its closed position,

a hinged lid operable between raised and lowered positions for covering the open upper end of said bowl when said lid is in its lowered position,

mechanical coupling means interconnecting said lid with said closure means for closing said closure means when said lid is lowered and for opening said closure means when said lid is raised,

means for blocking operation of said closure means to its open position during operation of said flow control means,

said coupling means permitting operation of said lid even when said shutter is blocked.

2. The apparatus of claim 1 in which said coupling means includes a first member coupled to said lid and a second member coupled to said closure means, and a slip-joint coupling said first and second members.

3. The apparatus of claim 1 in which said flush toilet includes a generally oblong outer casing, and an imperforate compartment defined at least in part by the inner bottom wall of said casing to receive said waste receptacle, said reservoir including the interior of said casing exteriorly of said compartment.

4. The apparatus of claim 1 in which said coupling means includes a shaft coaxial with the axis of rotation of said lid, at least one link member movable in translation in response to rotation of said shaft, said closure means comprising a generally planar member rotatable about a fixed axis, and means responsive to translation of said link member for rotating said planar member.

5. The apparatus of claim 1 which further includes a timing means for demarcating a predetermined interval when set into operation, a magnetically actuated reed switch having contacts whose closure initiates operation

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of said timing means, and means responsive to actuation of said closure means between its open and closed positions for causing closure of said switch contacts.

6. The apparatus of claim 1 which includes a trip-free circuit breaker having a push-button adapted to be actuated upon operation of said lid to its lowered position, switch means responsive to said closure means, and means responsive jointly to said circuit breaker and said switch means for operating said flow control means when said push-button has been actuated and concurrently said switch means has been operated to the condition it assumes when said closure means is in its closed position.

7. The apparatus of claim 1 which includes means for normally preventing operation of said flow control means except when said closure means is in its closed position, and by-pass switch means for operating said flow control means irrespective of the position of said closure means.

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HENRY K. ARTIS, Primary Examiner